PVD Design Report

Drain spacing to achieve U_s = 90 % at t = 365 days · probabilistic analysis

DECISION

Recommended spacing: P10 = **1,141 mm**, square pattern, 7,680 drains/ha, for U_s = 90 % at 365 days.

● P10 1,141 mm · ● P50 1,337 mm · ● P90 1,609 mm (square; the triangular equivalent of P10 is 1,226 mm)

Target	U_s (settlement-based) = 90 % at day 365	Treated depth	10.00 m, drains fully penetrating
Pattern	square	P10 identity	r_e 644 mm · r_w 33.1 mm · n 19.4 · 7,680 drains/ha
Vacuum	off	Creep	on (C_α/C_c: L1 0.040, L2 0.040)
Smear	k_h/k_s = 2.00, r_s/r_w = 2.27	Well resistance	q_w not entered; D ≥ 5 needs q_w ≥ 24 m³/year
Samples	100 of 100 accepted · seed 20260929	Drainage	radial only (vertical flow off)

Design spacing is the P10 of the sampled spacings. A smaller spacing is slower ground.

Project	Riverside Embankment — Stage 2	Job no.	EX-2026-004
Client	Example Infrastructure Authority	Document no.	EX-GEO-CAL-011
Site	Example site, VIC	Revision	A
Analysis	Design — probabilistic	Date of issue	2026-09-30
Purpose of issue	Example report — for illustration	Status	EXAMPLE
Prepared by	A. Engineer	Checked by	B. Checker
Approved by	C. Approver	Signature / date	

PROVENANCE PVDCal — PVD Design Tool, a GeotechLogic product · build 2026-10-01 07:35:33 · solver solveAxisym2D (radial) · Latin-hypercube seed 20260929 · samples 100 requested, 100 accepted · units m, kPa, days; mm for drain geometry, spacing and settlement

Contents

1. Introduction and scope 2
2. Basis of analysis 2
3. Analysis method 4
4. Results 5
5. Assumptions and limitations 8
6. Conclusions and recommendations 9
7. References 9
8. Software provenance and validation 10
Appendix A. Values behind the figures 11

PVDCal is a calculation aid. Responsibility for the design rests with the signing engineer.

1. Introduction and scope

This report presents a probabilistic design of ground improved with prefabricated vertical drains (PVDs) over a treated depth of 10.00 m comprising 2 soil layers. The objective is to determine the drain spacing required to reach a settlement-based degree of consolidation of U_s = 90 % within 365 days of the start of loading.

The analysis is **probabilistic**: the input parameters carrying a declared range were sampled by stratified Latin Hypercube over **100** accepted samples (of 100 requested), and the results are reported as P10 / P50 / P90 percentiles. The sampling plan was drawn from the recorded seed **20260929**, which travels with the project file: re-running this project reproduces the numbers in this report exactly. A different seed is a different draw of the same distributions, and the sampling interval quoted with each percentile in Section 4 is how far it would be expected to move. For design spacing the **P10** value is the conservative basis: it corresponds to the slowest 10 % of sampled profiles and therefore the tightest spacing required.

> This report was generated automatically from the analysis inputs and results. The numerical outputs are reproducible from the tabulated inputs: Section 2 gives the adopted value of every parameter and, for a probabilistic run, the range and distribution of every parameter that was sampled; Section 4 shows what each declared range, alone, did to the answer. Engineering judgement on the specific site, soil profile and construction sequence always supersedes the automated narrative in Section 6.

2. Basis of analysis

2.1 Soil profile: state and compression

Table 1 — Compression magnitudes and stress state as analysed. “Drains” records whether the drains reach that layer; a layer marked “no” consolidates vertically only.

Layer	H (m)	γ_{sat} (kN/m³)	e_0	C_c	C_r	σ'_p (kPa)	State	Drains
L1	4.00	16.0	1.60	0.500	0.050	45	OC	yes
L2	6.00	15.5	1.90	0.700	0.070	70	OC	yes

2.2 Soil profile: flow and stiffness

Table 2 — Hydraulic and stiffness properties. k_0 is the initial horizontal hydraulic conductivity, C_k the permeability-change index (change in void ratio per log cycle of k), β the sharpness of the transition of the compression index across σ'_p, and E_u the undrained modulus used for immediate settlement.

Layer	k_0 (m/s)	C_k	β	c_v (m²/d)	E_u (kPa)
L1	1.50e-9	0.800	5.0	*disabled*	3,000
L2	8.03e-10	0.950	5.0	*disabled*	5,000

c_v is shown as *disabled* because no layer carries a vertical coefficient: the run used the radial-only kernel and vertical flow contributed nothing. The consequence for this deliverable is stated in Section 5.

2.3 In-situ effective stress and over-consolidation

*Table 3 — Effective stress at each layer mid-depth, interpolated from the solver's own profile. $\sigma'_0(z) = \Sigma(\gamma - \gamma_w)\cdot\Delta z$ below the water table, using the unit weights in Table 1 and the groundwater level in Section 2.6, so every value here can be rebuilt by hand. The fifth column is the σ'_p of the **representative sampled profile** this report's curves come from — σ'_p carries a range (Table 5), so it is a draw from that range and will differ from the typed value without any clamping having occurred.*

Layer	z_{mid} (m)	σ'_0 (kPa)	σ'_p typed (kPa)	σ'_p this profile (kPa)	OCR	Interpretation
L1	2.00	12.4	45.0	48.6	3.92	drawn from the sampled range
L2	7.00	41.8	70.0	72.2	1.73	drawn from the sampled range

2.4 Drain and smear geometry

Drain product	band drain, 100 × 4.0 mm; equivalent $r_w = (w + t)/\pi$		
Equivalent drain radius r_w	33.1 mm	Radius of influence r_e	644 mm (P10 — see Section 4)
Spacing ratio $n = r_e/r_w$	19.4 (at the recommended P10 spacing)	Smear	k_h/k_s = 2.00, r_s/r_w = 2.27
Smear radius r_s	75 mm	Transition radius r_t	150 mm
Treated depth	10.00 m	Drain installation depth	10.00 m (fully penetrating)
Discharge capacity q_w (product)	— not entered —	Peak flow demand per drain	2.7 m³/year (first order)
Well resistance, $D = q_w/(k_h l_m^2)$	q_w was **not entered**, so D cannot be computed. With k_h = 1.50e-9 m/s (the fastest drained layer) and l_m = 10.0 m (one-way discharge), **D ≥ 5 requires q_w ≥ 24 m³/year** at the confining stress in the ground. Check the product against that figure.		

r_w above is the geometric equivalent radius of the drain cross-section; it has **not** been reduced to represent finite discharge capacity. Well resistance is therefore not included in this analysis. The demand figure is first order: the unit-cell area πr_e^2 times the peak rate of *primary* settlement, which is the water volume the drain must carry at its busiest. Immediate settlement is excluded because it is at constant volume. Compare it with the manufacturer's q_w at the confining stress and gradient expected in the ground, not at the catalogue value. See Section 5.

2.5 Loading schedule

Table 4 — Surcharge loading applied, stage by stage. Start is measured from the beginning of the analysis; "derivation" records how Δp was obtained.

Stage	Start (d)	Ramp (d)	Δp (kPa)	Derivation
1	0.0	30.0	100.0	entered directly as Δp

Cumulative final surcharge ΣΔp = **100.0 kPa** applied over an analysis window of t_{max} = **438 days** (1.20 × the target time of 365 d, so the response can be read past the design date). Vacuum preloading is **off**.

2.6 Hydrology and boundary conditions

Groundwater table z_{GWT}	0.00 m	Unit weight of water γ_w	9.81 kN/m³
Top boundary	drainage	Base boundary	impermeable

2.7 Numerical discretisation

Solver kernel	solveAxisym2D — radial-only layered kernel, cell-centred finite volume with Crank–Nicolson time stepping
Vertical slices	one unit cell per soil layer; the radial-only kernel requires no vertical mesh
Radial mesh	Zone-aware non-uniform finite volume; cell faces placed exactly at r_s and r_t; distance-weighted harmonic-mean face conductivities

2.8 Parameters sampled, and over what range

Table 5 — Every input that carried a declared spread, with the range and distribution the Latin Hypercube drew from. Parameters not listed here were held at the single value tabulated above and contribute no width to any reported band.

Layer	Parameter	Range sampled	Distribution	Drawn
L1	k_0 (m/s)	8.00e-10 – 2.80e-9	uniform over [min, max]	per layer
L1	C_k	0.720 – 0.880	uniform over [min, max]	per layer
L1	β	4.00 – 6.00	uniform over [min, max]	per layer

Table 5 (continued)

Layer	Parameter	Range sampled	Distribution	Drawn
L1	C_c	0.440 – 0.560	uniform over [min, max]	per layer
L1	C_r	0.0440 – 0.0560	uniform over [min, max]	per layer
L1	σ'_p (kPa)	38.0 – 52.0	uniform over [min, max]	per layer
L1	e_0	1.50 – 1.70	uniform over [min, max]	per layer
L1	E_u (kPa)	2600 – 3400	uniform over [min, max]	per layer
L2	k_0 (m/s)	4.30e-10 – 1.50e-9	uniform over [min, max]	per layer
L2	C_k	0.860 – 1.04	uniform over [min, max]	per layer
L2	β	4.00 – 6.00	uniform over [min, max]	per layer
L2	C_c	0.620 – 0.780	uniform over [min, max]	per layer
L2	C_r	0.0620 – 0.0780	uniform over [min, max]	per layer
L2	σ'_p (kPa)	60.0 – 80.0	uniform over [min, max]	per layer
L2	e_0	1.78 – 2.02	uniform over [min, max]	per layer
L2	E_u (kPa)	4300 – 5700	uniform over [min, max]	per layer

Smear (η, r_s, r_t) was held **deterministic** at the values in Section 2: one rig installs every drain, so these are drawn once per sample when ranged, and not at all here.

Admissibility. A drawn parameter set is clamped, not discarded, when it falls outside the physical caps: C_c/C_r held within the configured window, β within its sampling bounds, and σ'_p never below the in-situ σ'_0 at that depth. Of 200 draws, 0 were clamped on C_c/C_r, 0 on σ'_p and 0 on β. A sample counts as unusable only when the solver cannot bracket the target at any tested spacing; those are counted separately in Section 4.

3. Analysis method

Governing model. Radial (and, where $c_v > 0$, coupled radial–vertical) consolidation is solved on a cell-centred finite-volume grid. Face conductivities are distance-weighted harmonic means, so flux is conserved across sharp permeability contrasts at the smear and transition boundaries and at layer interfaces. Time integration is Crank–Nicolson for the radial kernel and Peaceman–Rachford ADI for the coupled problem.

Stress-dependent properties. Compression follows a smooth transition of the compression index across σ'_p, at a sharpness set by β: the operative index follows the recompression slope C_r while $\sigma' < \sigma'_p$ and the virgin slope C_c once $\sigma' > \sigma'_p$. β is a shape parameter of that transition, not a hydraulic quantity. Hydraulic conductivity starts at k_0 and decreases with void ratio through C_k, so the operative $c_h(\sigma') = k_h(\sigma') / (m_v(\sigma')\cdot\gamma_w)$ is re-evaluated at every step rather than held constant.

Design search. The required radius of influence is found by bisection on r_e: the solver is re-run at each trial spacing and the bracket closed until the settlement-based degree of consolidation at the target time matches the target U_s. Centre-to-centre spacings for square and triangular installation patterns follow from the converged r_e by equal-area conversion ($S_{square} = r_e\sqrt{\pi}$, $S_{triangular} = r_e\sqrt{(2\pi/\sqrt{3})}$).

Uncertainty propagation. Inputs carrying a declared range were sampled by stratified Latin Hypercube. Every sample is solved independently with its own bisection, and the reported P10 / P50 / P90 values are percentiles of the resulting distribution. Smear parameters (η, r_s, r_t) are sampled globally rather than per layer, because one installation rig installs every drain on the site.

Degree of consolidation. U_s is the settlement-based degree of *primary* consolidation and cannot exceed 100 %: creep (where enabled), immediate undrained settlement and any other add-on are carried in the reported settlement but are deliberately excluded from the U numerator. U_p is the pore-pressure-based degree of consolidation.

4. Results

4.1 Required drain spacing

*Table 6 — Radius of influence, centre-to-centre spacing, spacing ratio and drain density at each percentile of the sampled design distribution. Drain density is one drain per S² on a square pattern and one per (√3/2)·S² on a triangular pattern, which is the number an installer prices. The two agree to rounding by construction, because the pattern conversion preserves the unit-cell area; a disagreement would indicate an error. The **sampling interval** is what re-running the same analysis with a fresh sample set of the same size would be expected to give, 9 times in 10: each percentile is an order statistic of **100** samples, and an order statistic moves even when the model and the inputs do not. It is the uncertainty of the SAMPLING, not of the ground, which Table 5 covers; the two are separate and both real. Because it is computed without assuming a distribution and without crediting the Latin-Hypercube stratification, it is on the conservative side.*

Percentile	r_e (mm)	r_e sampling interval (mm)	Square S (mm)	Triangular S (mm)	n = r_e/r_w	Drains/ha (sq.)	Drains/ha (tri.)	Interpretation
● **P10**	644	591–674	**1,141**	1,226	19.4	7,680	7,680	slowest 10 % of profiles — **conservative design basis**
● P50	754	733–782	1,337	1,437	22.8	5,595	5,595	median
● P90	908	868–930	1,609	1,729	27.4	3,863	3,863	fastest 10 % — unconservative unless justified

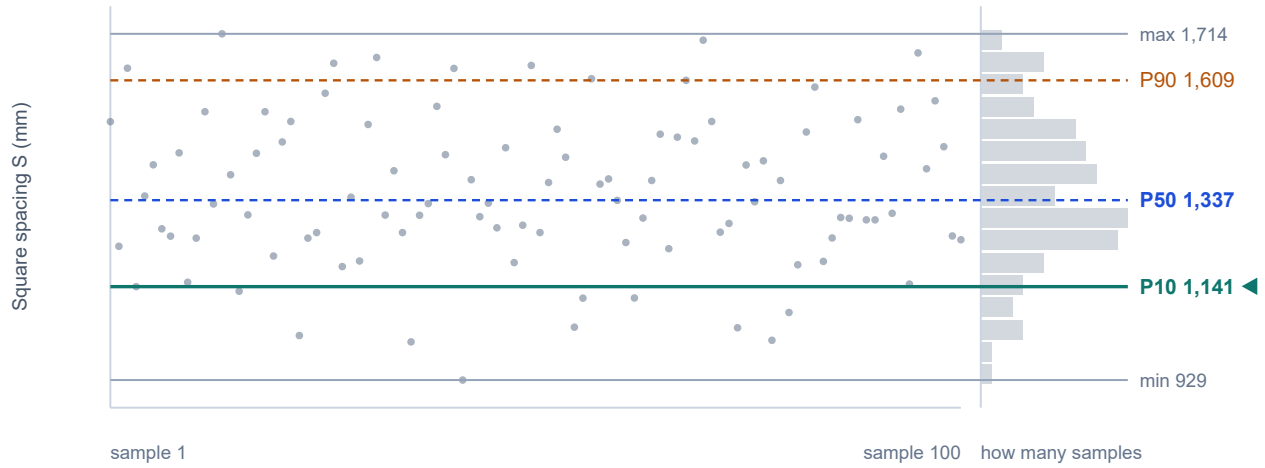

*Figure 1 — Every accepted sample's required square spacing (one dot per sample, grey), in the order the run produced them, with the distribution of the same numbers down the right-hand side. This is the picture behind the three percentiles in the table above: three numbers cannot show whether the samples are bunched or spread, nor how thin the tail the design is taken from actually is. **P10 is the slowest tenth of the sampled grounds** and therefore the SMALLEST spacing here — the same label sits on the LARGEST number in a Simulate report, because there the slow ground gives the longest wait. The line marked with an arrow on the figure is the conservative end in both. P10, P50 and P90 are drawn in the colours used throughout this report. The plotted values are in Table A2 of the appendix.*

4.2 What moved the spacing

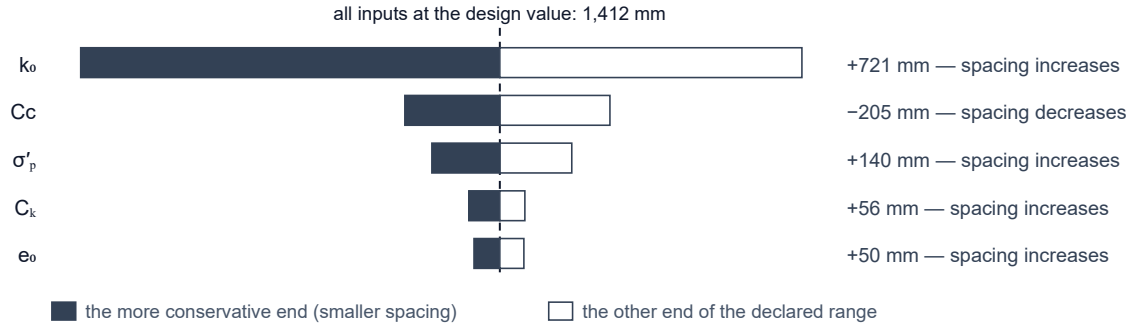

Figure 2 — Each bar is that input alone, from its declared low value to its declared high value. The filled side is the end that makes the result more conservative: a smaller spacing on Design, a later day on Simulate. The P10–P90 band remains the joint result. Bars shorter than 50 mm are omitted.

Other ranged inputs moved the spacing by less than 38 mm.

Table 7 — The bars of Figure 2, in the same order: the square spacing with that input alone at its declared low and at its declared high value. The design answer is the P10 spacing of Section 4.1, not any of these.

#	Input	At low (mm)	At high (mm)	Swing (mm)	Direction
1	k_0	993	1,714	+721	spacing increases
2	Cc	1,522	1,317	−205	spacing decreases
3	σ'_p	1,344	1,484	+140	spacing increases
4	C_k	1,381	1,437	+56	spacing increases
5	e_0	1,386	1,436	+50	spacing increases

4.3 Adverse corner

Square spacing at the corner	**832 mm** (14,446 drains/ha)
P10 design spacing	1,141 mm — the corner is 27 % tighter
Worst sampled profile (of 100)	929 mm

Table 8 — The corner itself: every input with a declared range, pinned at the end its own bar in Figure 2 found worse (the end that needs the smaller spacing). Inputs with no range are not listed; they stay at the design value.

Layer	Input	Pinned at	Value
L1	k_0	declared low value	8.00e-10
L2	k_0	declared low value	4.30e-10
L1	C_c	declared high value	0.560
L2	C_c	declared high value	0.780
L1	σ'_p	declared low value	38
L2	σ'_p	declared low value	60
L1	C_k	declared low value	0.720
L2	C_k	declared low value	0.860
L1	e_0	declared low value	1.500
L2	e_0	declared low value	1.780

Table 8 (continued)

Layer	Input	Pinned at	Value
L1	β	declared high value	6.000
L2	β	declared high value	6.000
L1	C_r	declared high value	0.056
L2	C_r	declared high value	0.078
L1	E_u	declared low value	2600.000
L2	E_u	declared low value	4300.000

> **A check, not a second recommended spacing.** Pinning every adverse end at once is conservative: those extremes are unlikely to occur together. The P10–P90 band remains the design result; the design spacing is the P10. The corner shows how far the declared ranges could push the answer if every one of them went the wrong way at the same time, and it moves with the ranges: widen one and this number moves with it.

Recommended design spacing: P10 = 1,141 mm, square pattern, 7,680 drains/ha (r_e = 644 mm, n = 19.4). The triangular equivalent is 1,226 mm at 7,680 drains/ha. Design spacing is the P10 of the sampled spacings. A smaller spacing is slower ground. Samples accepted: 100 of 100.

4.4 Settlement at the recommended spacing

Total settlement at t = 365 d (target) (primary + creep + immediate)	**1,174 mm** (P10–P90: 1,099–1,257 mm)
Total settlement at t_{max} = 438 d (primary + creep + immediate)	**1,213 mm** (P10–P90: 1,137–1,304 mm)
Ultimate primary settlement S_∞ (primary consolidation only)	827 mm (P10–P90: 758–913 mm)

Why the total exceeds S_∞. S_∞ is the ultimate PRIMARY consolidation settlement. The total settlement rows add secondary compression and immediate undrained settlement where those are enabled, so a total at any date can legitimately exceed S_∞, and certainly exceeds $S_\infty \times U_S$. The band is the P10–P90 envelope of the sampled profiles at each instant, so the P10 settlement curve is not in general the same sample as the P10 spacing.

PVDCal is a calculation aid. Responsibility for the design rests with the signing engineer.

4.5 Consolidation against time

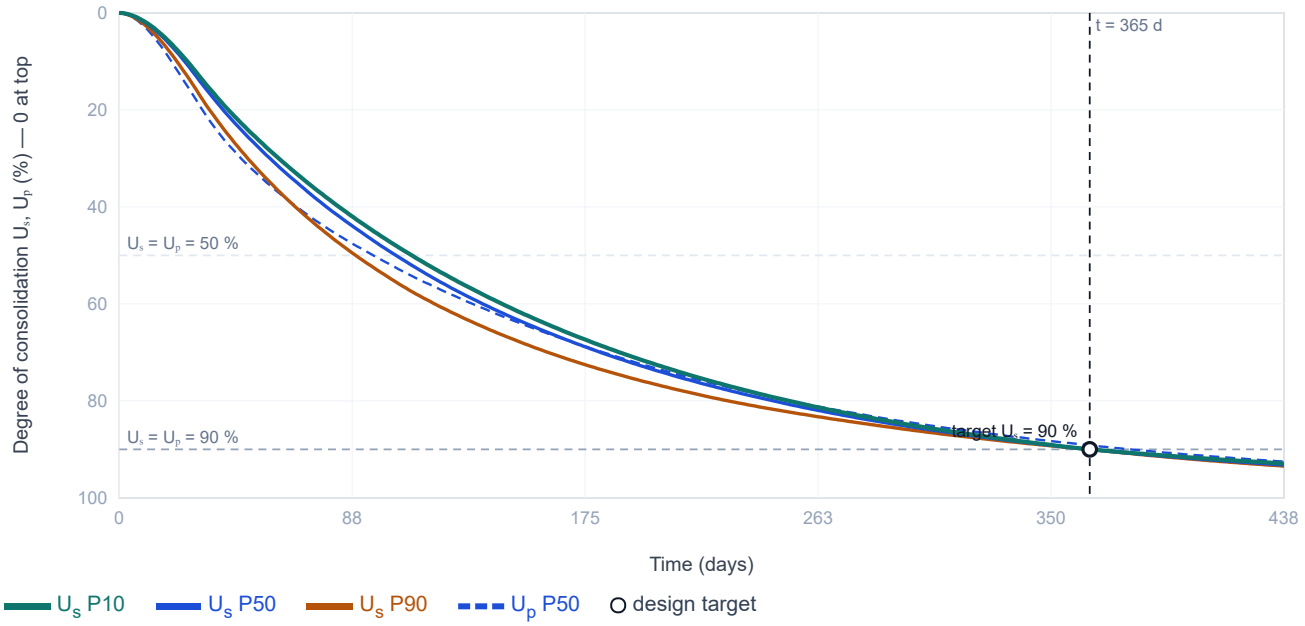

*Figure 3 — Settlement-based degree of consolidation U_s against time. The three solid lines are the **pointwise P10, P50 and P90** of the 100 accepted samples at each instant — each is a percentile of the sampled curves, not one sample. The dashed line is the pore-pressure-based U_p at P50. U increases downward, so the axis reads the same way round as the settlement figure. **Each sample is plotted at its own designed r_e**, so every curve passes through the target by construction; this is not the spread at the single recommended spacing. The plotted values are in Table A1 of the appendix.*

4.6 Settlement against time

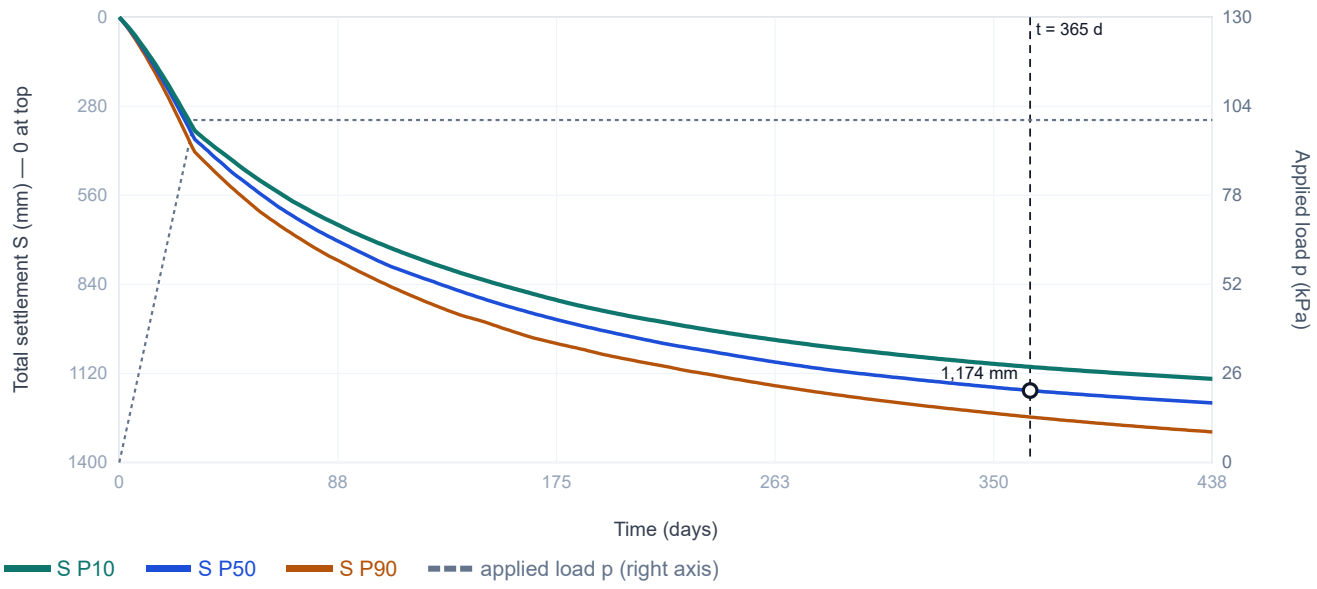

Figure 4 — Cumulative surface settlement against time: the pointwise P10, P50 and P90 of the sampled settlement curves (each a percentile at each instant, not one sample), with the applied surcharge p(t) of the loading schedule on the right-hand axis. Settlement is plotted downward and includes creep and immediate settlement where those are enabled. The plotted values are in Table A1 of the appendix.

5. Assumptions and limitations

- The soil profile, compression parameters and hydraulic conductivities tabulated in Section 2 are taken as given; this analysis does not validate the site investigation from which they derive.

- Drains are assumed fully penetrating over the treated depth and uniformly installed on a regular pattern, with the unit cell idealised as axisymmetric about a single drain.
- **Well resistance is not modelled.** r_w is the geometric equivalent radius of the drain cross-section and has not been reduced to represent finite discharge capacity. q_w must be checked separately against the peak flow demand implied by the early-time consolidation rate, particularly for long drains; the D line in Section 2.4 states the check for this run.
- **Vertical drainage is disabled** (radial-only kernel): only radial flow contributes. Because the search solves for the spacing that reaches the target, switching vertical flow off slows the unit cell and therefore returns a **tighter** spacing than a coupled run would. That is conservative on spacing; confirm the conservatism is intended.
- The reported percentiles propagate only the input ranges that were declared. Parameters left deterministic contribute no uncertainty to the band, so the true spread is wider than reported wherever a significant parameter was fixed.
- Secondary compression (creep) is reported within the settlement where enabled but is excluded from the degree of consolidation by definition.
- Construction effects not modelled here — mandrel disturbance beyond the declared smear zone, drain crimping or necking, installation out of tolerance, and staged fill placement differing from the loading schedule in Section 2 — will alter the achieved performance.

6. Conclusions and recommendations

At the specified geometry the analysis indicates a conservative (P10) square drain spacing of **1,141 mm** (7,680 drains/ha) to achieve U_s = 90 % at t = 365 days, on the basis of the inputs tabulated in Section 2.

1. The design basis is the P10, and it is the percentile this sample set determines least well: re-running with a fresh set of 100 samples would be expected to place it between **591 and 674 mm** (13 % of the value), 9 times in 10. That is sampling, not ground uncertainty. If a difference smaller than that would change a decision, re-run with about **400 samples** — the interval narrows like 1/√N, so halving it costs four times the samples — or design to the **tighter end, r_e = 591 mm**. For a SPACING the conservative end is the smaller radius: the wider one consolidates more slowly and would miss the target. Naming which end is not pedantry — this same report has to say *P10 is the slow tail* about a duration, because for a time the conservative percentile runs the other way.
2. Vertical drainage is disabled, so the spacing above is tighter than a coupled run would give. For thick layers (H > 4–5 m) with appreciable c_v, enable it and compare: the conservatism may be larger than intended.
3. The profile contains over-consolidated layers, so σ'_p tracking is active. Check the OCR column of the effective-stress table in Section 2 against the site investigation: any layer flagged as clamped was entered with σ'_p below the in-situ σ'_0 and should be corrected at source.

7. References

1. Barron, R.A. (1948). Consolidation of fine-grained soils by drain wells. Transactions ASCE, 113, 718–754. — radial consolidation about a single drain, the ideal-drain limit of this unit cell
2. Hansbo, S. (1981). Consolidation of fine-grained soils by prefabricated drains. 10th ICSMFE, Stockholm, vol. 3, pp. 677–682. — radial consolidation with smear and well resistance; the closed form the radial kernel is validated against
3. Indraratna, B., Redana, I.W. (1998). Laboratory determination of smear zone due to vertical drain installation. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 124(2), 180–184. — laboratory determination of the smear zone, the basis for the adopted r_s and η
4. Sharma, J.S., Xiao, D. (2000). Characterization of a smear zone around vertical drains by large-scale laboratory tests. Canadian Geotechnical Journal, 37, 1265–1271. — large-scale laboratory characterisation of the smear zone around a vertical drain
5. Walker, R. and Indraratna, B. (2006). Vertical drain consolidation with parabolic distribution of permeability in smear zone. Journal of Geotechnical and Geoenvironmental Engineering, ASCE, 132(7), 937–941. — permeability varying through the smear annulus, the behaviour represented here by the transition zone $r_s \rightarrow r_t$

6. Indraratna, B., Rujikiatkamjorn, C. and Sathananthan, I. (2005). Radial consolidation of clay using compressibility indices and varying horizontal permeability. Canadian Geotechnical Journal, 42(5), 1330–1341. — radial consolidation formulated on compressibility indices and varying horizontal permeability — the C_c/C_k formulation this solver uses
7. Abuel-Naga, H.M., Pender, M.J. (2012). Modified Terzaghi consolidation curves with effective stress dependent coefficient of consolidation. Géotechnique Letters, 2, 43–48. — effective-stress-dependent coefficient of consolidation, the basis for re-evaluating $c_h(\sigma')$ at every step

The list above is assembled from the physics this run used: smear and transition references are included because η > 1. Vacuum references are omitted because no vacuum is applied.

8. Software provenance and validation

Produced by **PVDCal — PVD Design Tool**, a GeotechLogic product, build **2026-10-01 07:35:33**. This file was computed with the **radial-only kernel (solveAxisym2D)**.

Table 9 — The closed-form benchmark suite that ships inside the application, reproducible from its Validation page. Errors are in percentage points of the degree of consolidation. Rows marked • are the checks that govern the kernel used for this file.

Benchmark	What it tests	Mean abs. error (pp)	Max error (pp)
Olson–Barron •	ramp loading, ideal drain	0.398	0.742
Hansbo •	radial consolidation with smear	0.299	1.030
Hansbo, layered solver •	layered stack, ideal drain	0.530	2.179
Hansbo with smear, layered solver •	layered stack, with smear	0.254	0.963
Terzaghi	pure vertical drainage	0.116	1.119
Carrillo	radial and vertical combined	0.000	0.001
Vacuum-assisted	suction boundary condition	0.530	2.178
Partial penetration	limits: full ≡ Hansbo, none ≡ Terzaghi	0.016	0.290

Spatial convergence is second order in both directions: 0.021 percentage points of U at 80 radial cells against a 640-cell reference, and 0.120 percentage points RMS at the default Δz = 0.5 m against the exact Terzaghi series. The discretisation, its measured convergence behaviour and the full benchmark set are documented in the accompanying *Numerical Method Guide*, and every benchmark above can be re-run from inside the application rather than taken from this page.

> **Responsibility.** These results depend on the input parameters tabulated in Section 2 and on the assumptions and limitations in Section 5. The narrative in Section 6 is generated automatically from the headline statistics and the configuration of this run: it is a checklist prompt, not a signed opinion. The software is a calculation aid; responsibility for the design rests with the signing engineer.

Appendix A. Values behind the figures

Every curve in Section 4 is read from these tables at the dates listed; between them the figures interpolate linearly on the solver's own time steps. p is the applied surcharge from the loading schedule in Section 2.5. Each P10 / P50 / P90 column is the pointwise percentile of the 100 accepted samples at that date.

Table A1 — Degree of consolidation, settlement and applied load at selected dates.

t (d)	p (kPa)	U_s P10 (%)	U_s P50 (%)	U_s P90 (%)	U_p P50 (%)	S P10 (mm)	S P50 (mm)	S P90 (mm)
0	0.0	0.0	0.0	0.0	0.0	0	0	0
7	23.3	1.0	1.1	1.4	1.7	65	70	76
14	46.7	3.6	3.8	4.8	5.7	143	153	169
30	100.0	13.0	13.9	16.8	18.9	354	380	420
60	100.0	30.0	31.7	36.8	37.1	532	575	632
90	100.0	42.9	44.8	50.4	48.3	662	713	774
120	100.0	53.2	55.2	60.4	56.8	759	816	885
150	100.0	61.6	63.3	67.7	63.8	835	895	968
180	100.0	68.4	69.8	73.3	69.7	899	960	1,034
240	100.0	78.5	79.3	81.2	78.6	988	1,055	1,128
300	100.0	85.2	85.5	86.2	84.7	1,051	1,123	1,200
365	100.0	90.0	90.0	90.0	89.2	1,099	1,174	1,257
438	100.0	92.9	93.2	93.4	92.5	1,137	1,213	1,304

Table A2 — Every accepted sample's required square spacing (mm), in the order the run produced them: the values behind the sample-cloud figure in Section 4. Sorting them and reading the 10th, 50th and 90th percentile reproduces the P10, P50 and P90 of Section 4.

Samples	+0	+1	+2	+3	+4	+5	+6	+7	+8	+9
1–10	1515	1233	1637	1141	1347	1417	1272	1255	1444	1151
11–20	1251	1538	1329	1714	1395	1131	1304	1444	1538	1210
21–30	1469	1516	1030	1251	1263	1580	1648	1187	1344	1199
31–40	1509	1661	1303	1404	1264	1015	1303	1329	1550	1441
41–50	1636	929	1383	1300	1330	1274	1456	1195	1280	1643
51–60	1263	1377	1498	1434	1049	1115	1612	1374	1385	1337
61–70	1241	1115	1297	1382	1487	1227	1480	1609	1472	1700
71–80	1516	1264	1284	1048	1417	1333	1426	1019	1382	1082
81–90	1191	1492	1594	1198	1252	1298	1296	1520	1292	1292
91–100	1437	1307	1544	1147	1671	1409	1562	1458	1256	1247

PVDCal is a calculation aid. Responsibility for the design rests with the signing engineer.